



Aspects of land surface hydrology in the NMME

Huug van den Dool and Emily Becker
Climate Prediction Center (CPC)

*Acknowledgements: Qin Zhang, Suranjana Saha,
Malaquias Pena and many others.*

Lets talk SST

- Suppose we know that the Pacific SST has an impact over the US. How do we take predictive advantage of that knowledge in a modeling approach ?
- Make sure the model has the appropriate mechanisms
- Make sure we initialize models correctly
- Let us thank Nature for providing such things as El Nino and La Nina for our test grounds
- Now apply the above to the land surface

Hindcast Situation YEAR 1

Model resident Resolutions

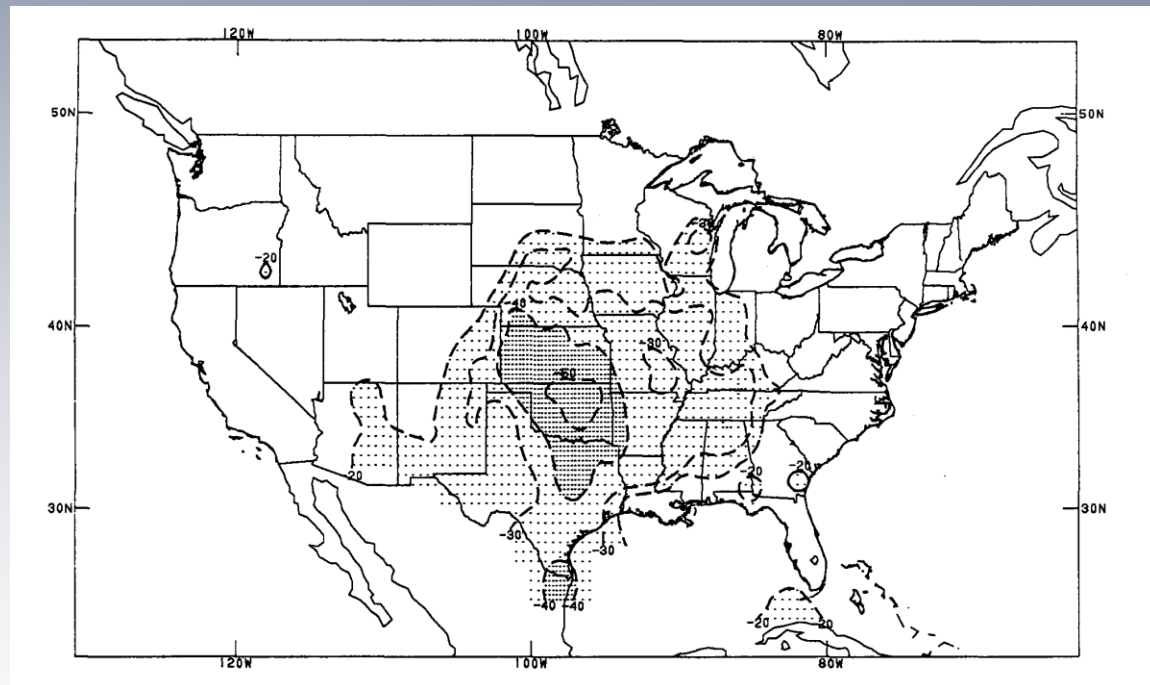
	Start months available NOW			Period	Members	Arrangement of Members	Lead (months)	Atmosphere		Ocean	Reference		
NCEP- CFSv1	12			1981- 2009	15	1 st 0Z +/-2days, 11 th 0Z+/-2d, 21 st 0Z+/-2d	0-9	T62L64		MOM3L40 0.30 deg Eq	Saha et al 2006		NCEP- CFSv1
NCEP- CFSv2	12			1982- 2010	24(28)	4 members (0,6,12,18Z) every 5th day	0-9	T126L64		MOM4 L40 0.25 deg Eq	Saha et al 2012		NCEP- CFSv2
GFDL- CM2.1	12			1982- 2010	10	All 1st of the month 0Z	0-11	2x2.5deg L24		MOM4 L50 0.25 deg Eq	Delworth et al 2006		GFDL- CM2.1
IRI- Echam4-f	12			1982- 2010	12	All 1st of the month**	0-7	T42L19		MOM3 L25 0.5 deg Eq	DeWitt MWR2005		IRI- Echam4-f
IRI- Echam4-a	12			1982- 2010	12	All 1st of the month**	0-7	T42L19		MOM3 L25 0.5 deg Eq	"		IRI- Echam4-a
NCAR- CCSM3.0	12			1982- 2010	6	All 1st of the month**	0-11	T85L26		POP L40 0.3 deg Eq	Kirtman and Min 2009		NCAR- CCSM3.0
NASA	12			1981- 2010	6	1 member every 5th day as CFSv2	0-9	1x1.25deg L72		MOM4 L40 0.25 deg Eq	Rienecker et al 2008		NASA

Hindcast Situation YEAR 2					Model resident Resolutions									
	Start months available NOW			Period	Members	Arrangement of Members	Lead (months)		Atmosphere	Ocean	Reference			
NCEP-CFSv1	12			1981-2009	15	1 st 0Z +/-2days, 11 th 0Z+/-2d, 21 st 0Z+/-2d	0-9		T62L64	MOM3L40 0.30 deg Eq	Saha et al 2006		NCEP-CFSv1	
NCEP-CFSv2	12			1982-2010	24(28)	4 members (0,6,12,18Z) every 5th day	0-9		T126L64	MOM4 L40 0.25 deg Eq	Saha et al 2010		NCEP-CFSv2	
GFDL-CM2.1	12			1982-2010	10	All 1st of the month 0Z	0-11		2x2.5deg L24	MOM4 L50 0.30 deg Eq	Delworth et al 2006		GFDL-CM2.1	
CMC1-CanCM3	12			1981-2010	10	All 1st of the month 0Z	0-11		CanAM3 T63L31	CanOM4 L40 0.94 deg Eq	Merryfield et al 2012		CMC1	
CMC2-CanCM4	12			1981-2010	10	All 1st of the month 0Z	0-11		CanAM4 T63L35	CanOM4 L40 0.94 deg Eq	Merryfield et al 2012		CMC2	
NCAR-CCSM3.0	12			1982-2010	6	All 1st of the month**	0-11		T85L26	POP L40 0.3 deg Eq	Kirtman and Min 2009		NCAR-CCSM3.0	
NASA	12			1981-2010	6	1 member every 5th day as CFSv2	0-9		1x1.25deg L72	MOM4 L40 1/4 deg at Eq	Rienecker et al 2008		NASA	

Land surface hydrology

- Do we have the mechanism for feedback onto the atmosphere in these models?
- Do we know how to initialize in particular cases?

- 1-mon lagged correlation between precip and temp turns out to be negative
- Dry July \rightarrow warm Aug; Wet July \rightarrow cool Aug

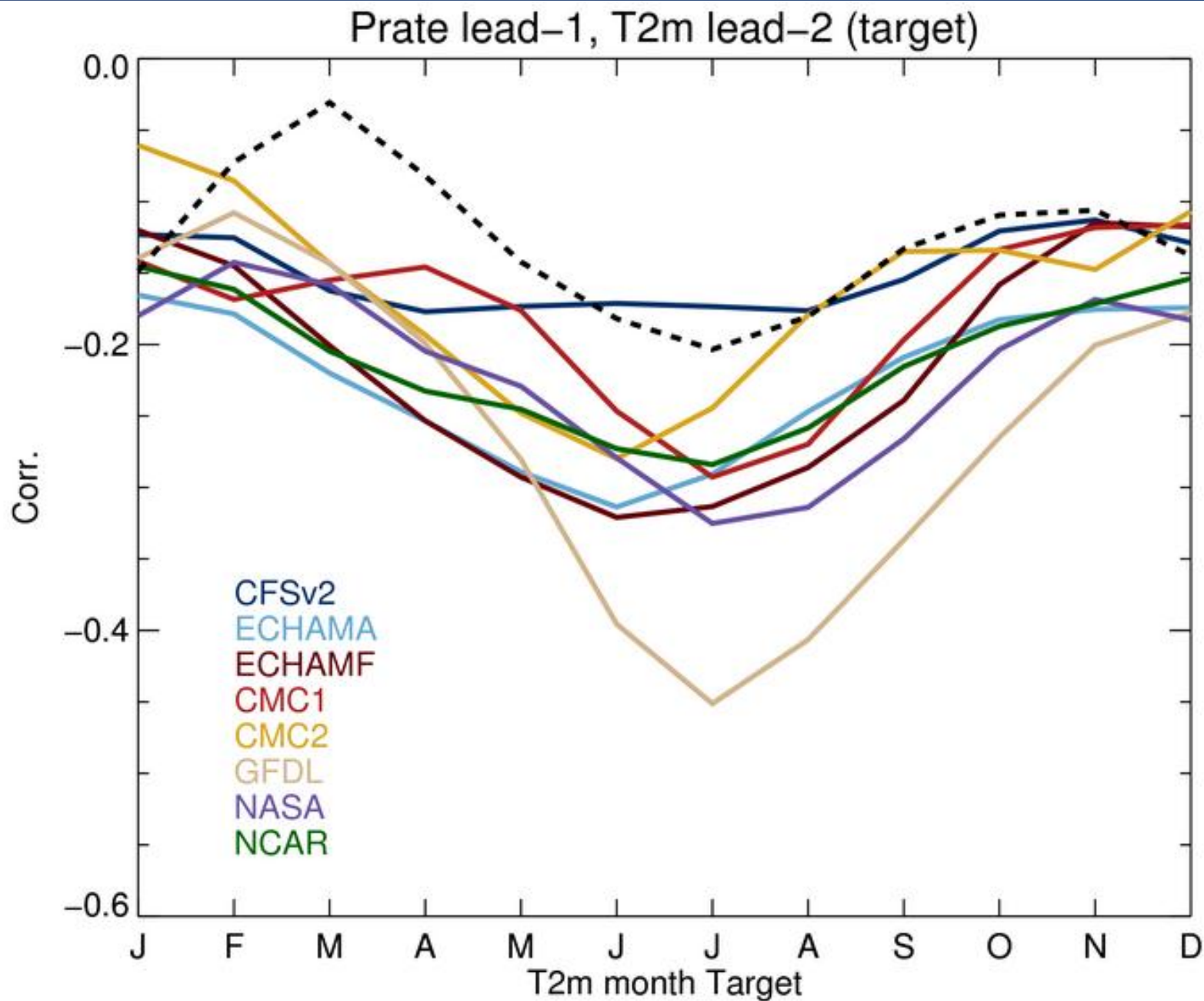


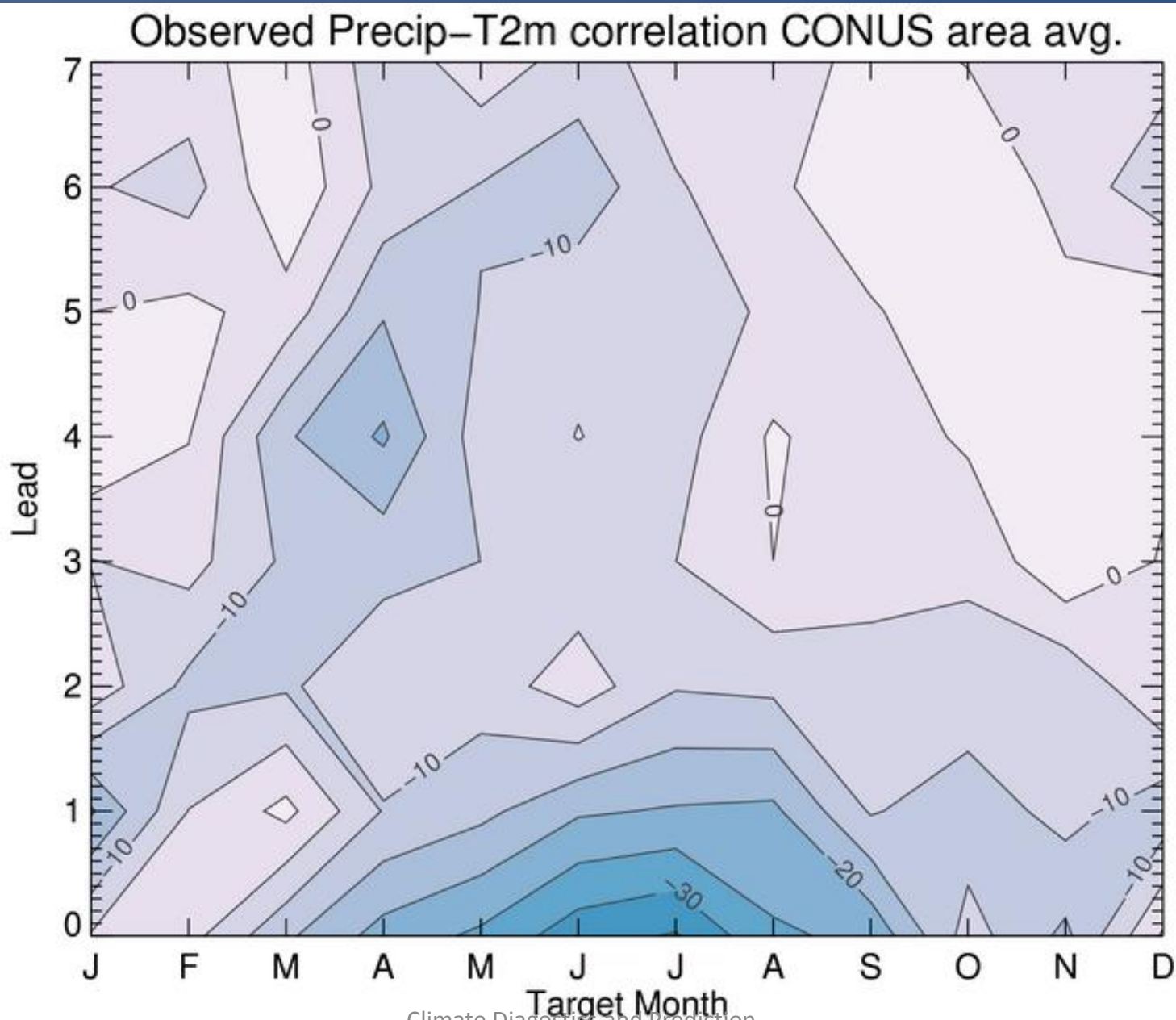
Monthly Precipitation-Temperature Relations and Temperature Prediction over the United States

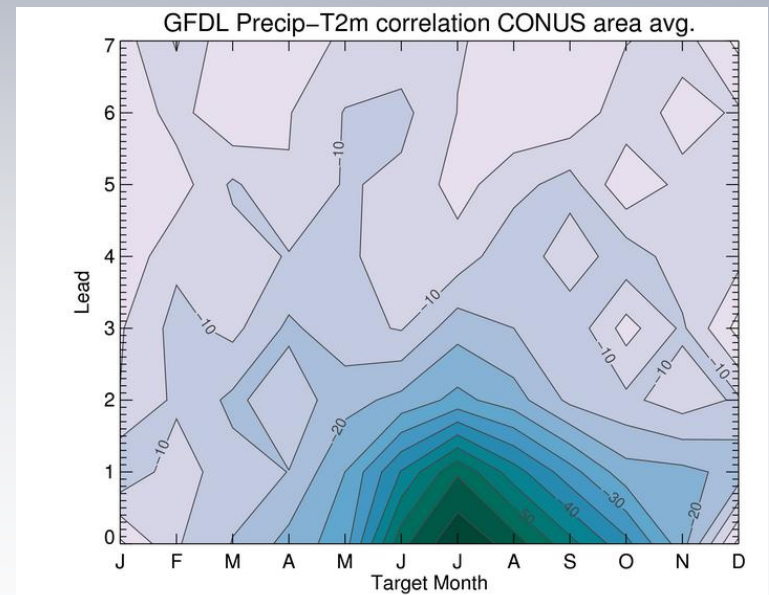
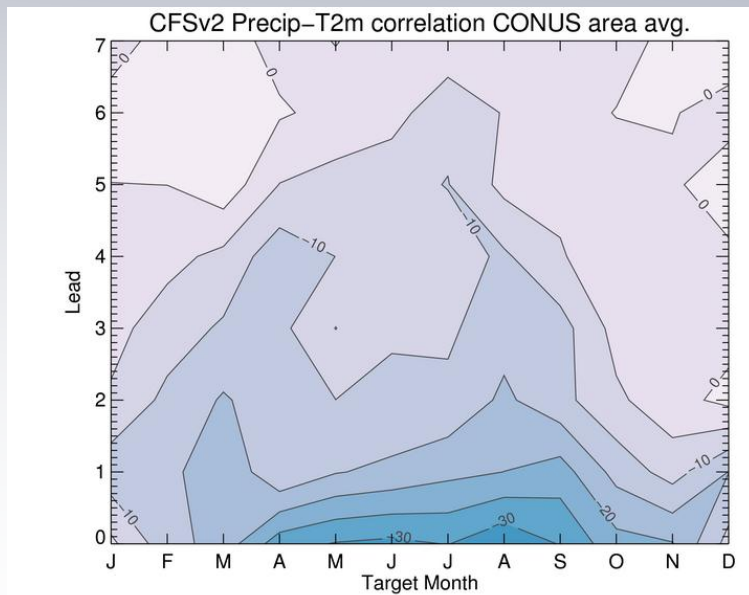
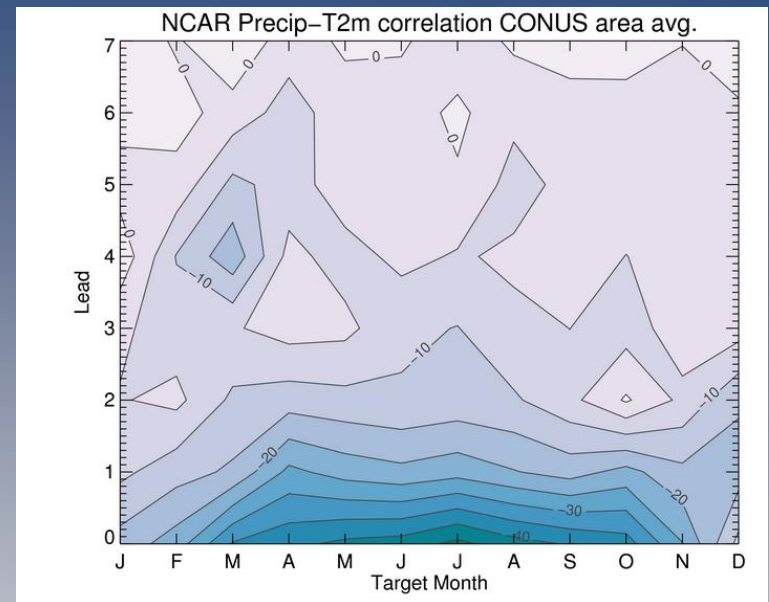
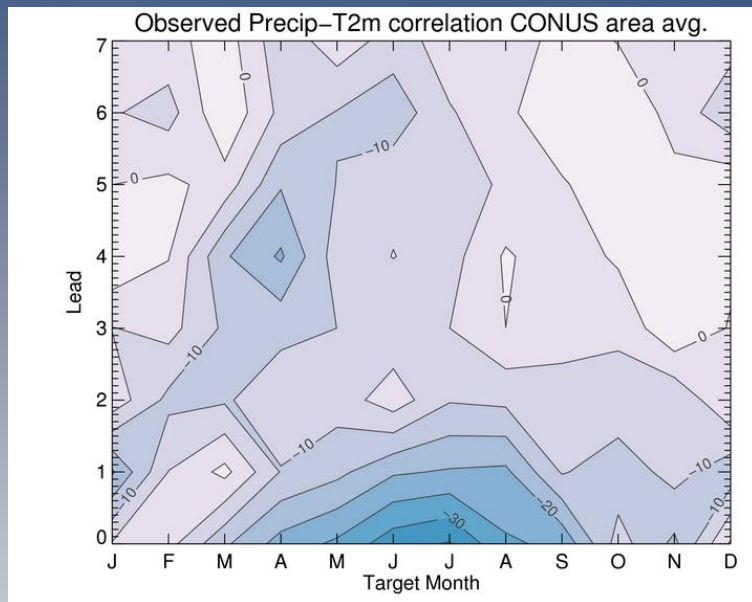
JIN HUANG AND HUUG M. VAN DEN DOOL

Climate Diagnostics and Prediction
Workshop College Park, MD

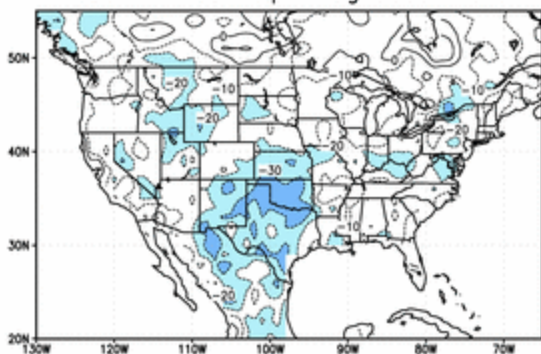
Huang & VdDool
paper 1993 paper:
CD data 1931-
1987



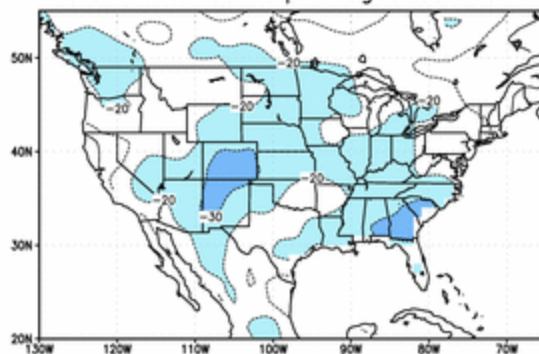




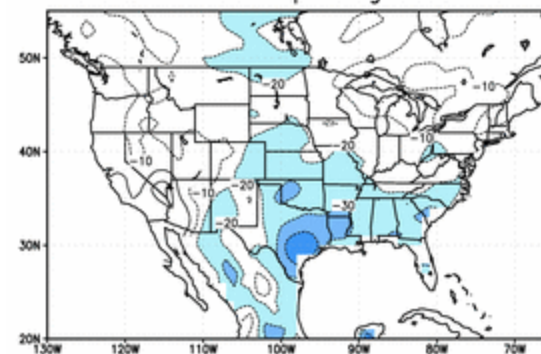
obs P-T corr Apr-Aug base mon.



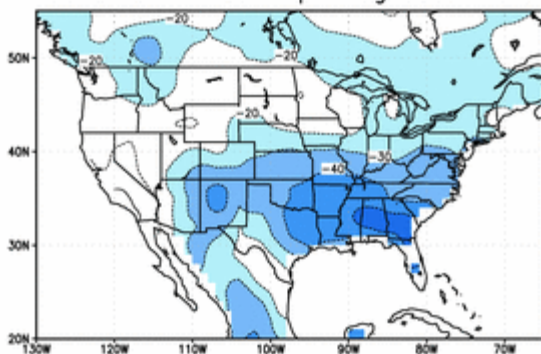
cfsv1 P-T corr Apr-Aug base mon.



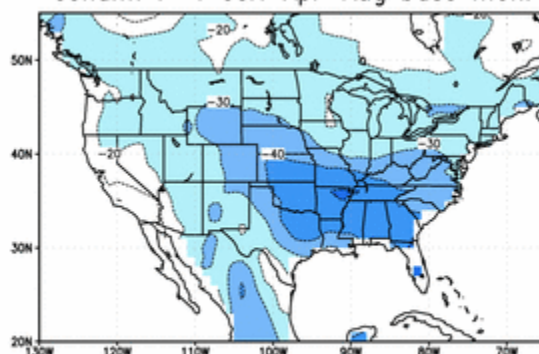
cfsv2 P-T corr Apr-Aug base mon.



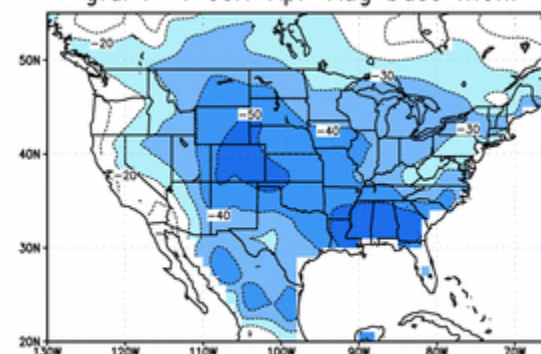
echama P-T corr Apr-Aug base mon.



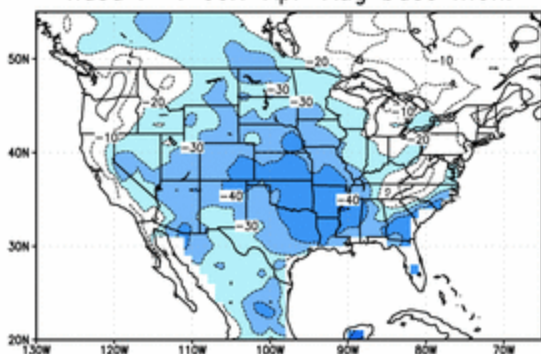
echamf P-T corr Apr-Aug base mon.



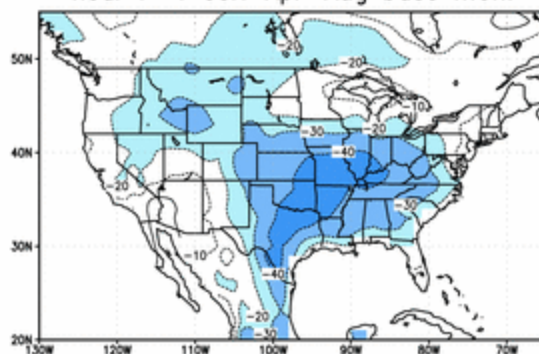
gfdl P-T corr Apr-Aug base mon.



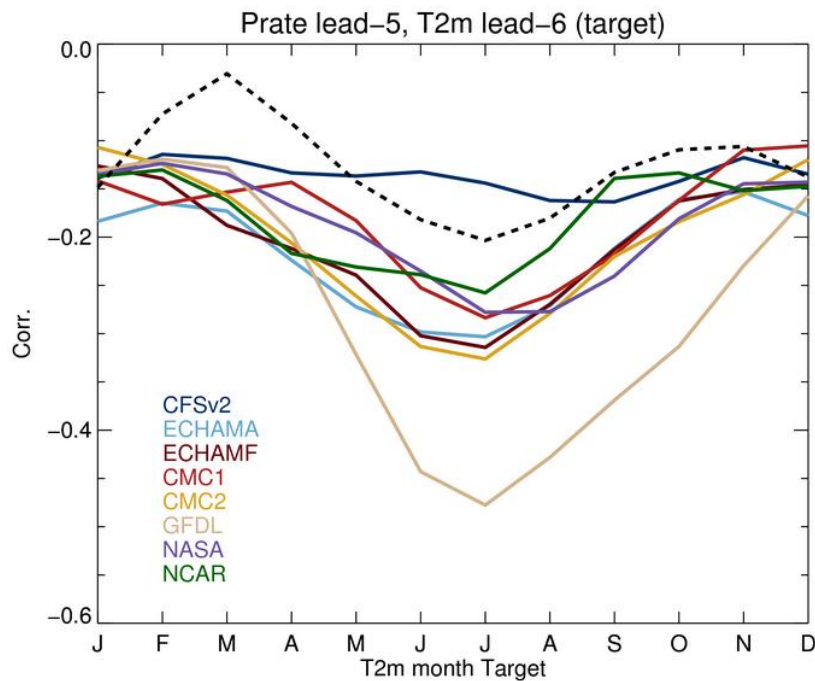
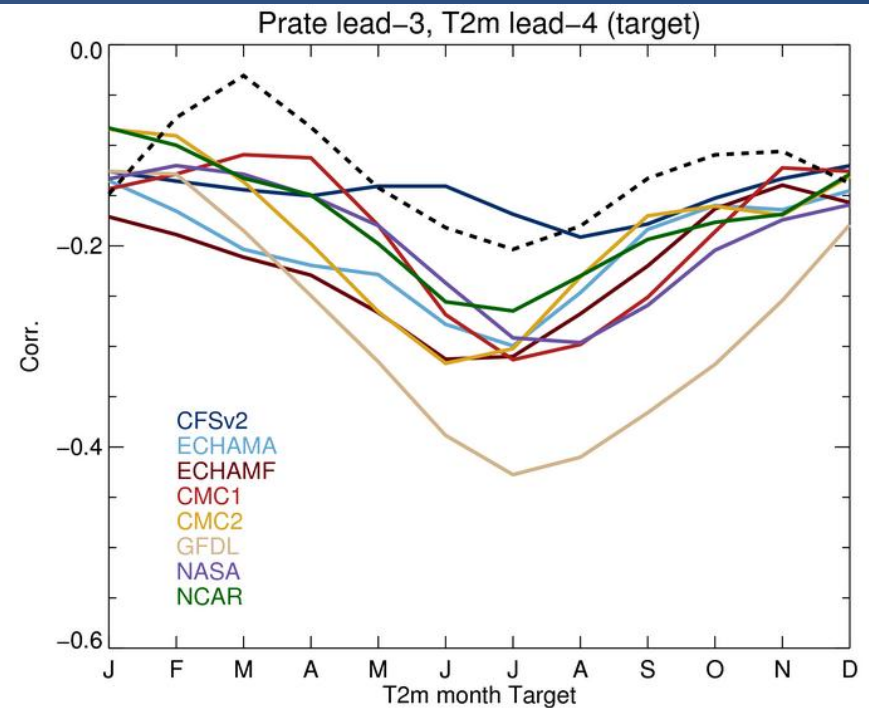
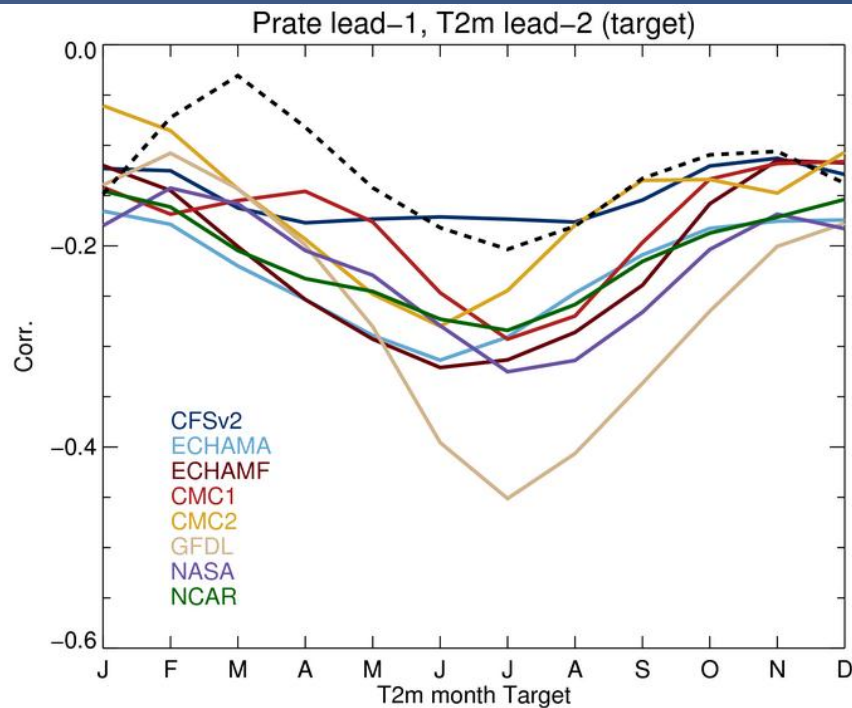
nasa P-T corr Apr-Aug base mon.



ncar P-T corr Apr-Aug base mon.



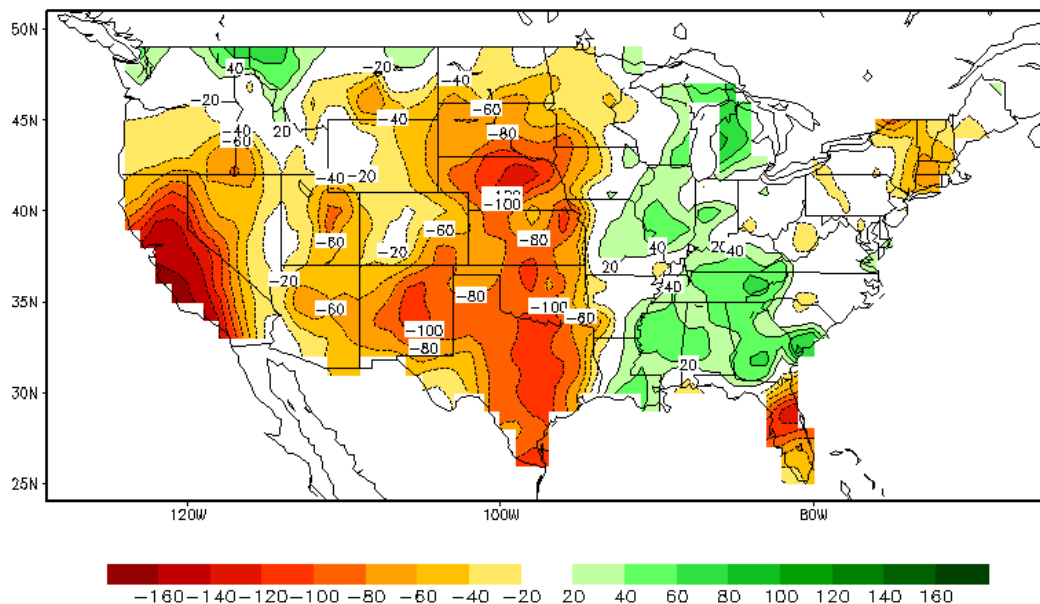
Single member one-month lag Precip-Temp correlation averaged for April – Aug base month (May – Sept temperature)



Soil Moisture as Initial Condition in NMME

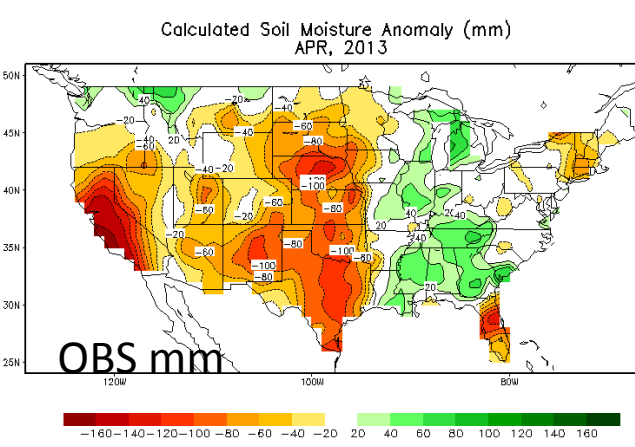
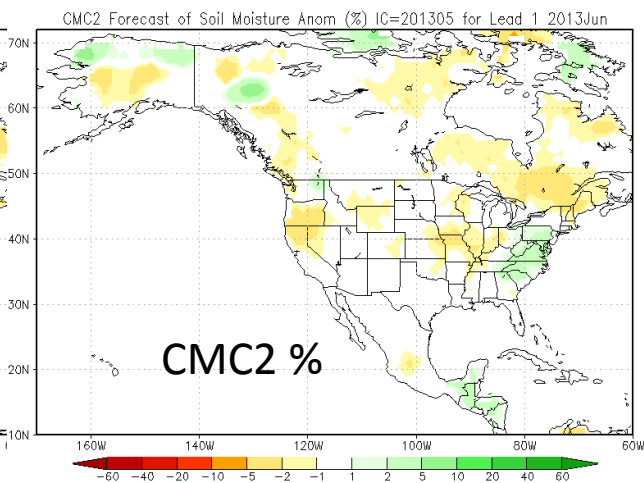
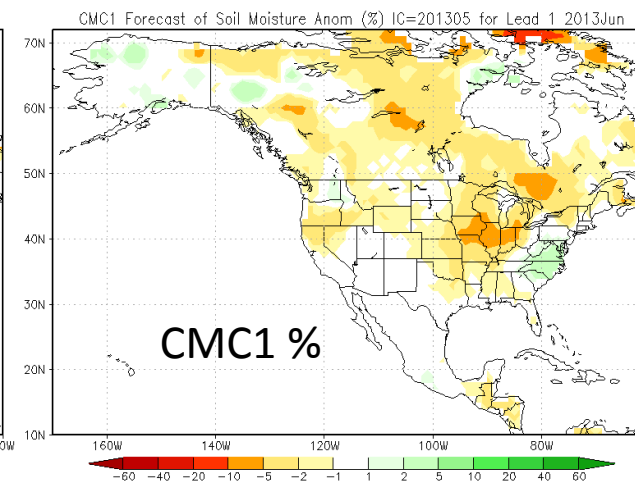
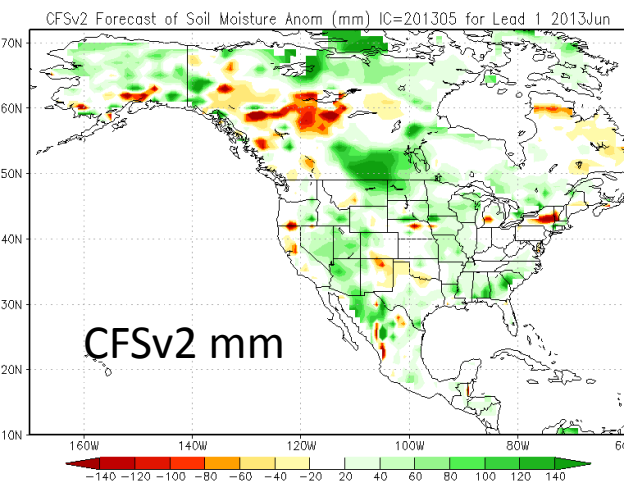
- SM is one of the 5 extra phase I variables. SM is advertised to matter for seasonal prediction in the warm half of the year.
- Have yet to agree on units in practice
- Real time display in place (May starts)
- IC=about May 1, 2013.
- Forecast refers to June 2013

Calculated Soil Moisture Anomaly (mm)
APR, 2013

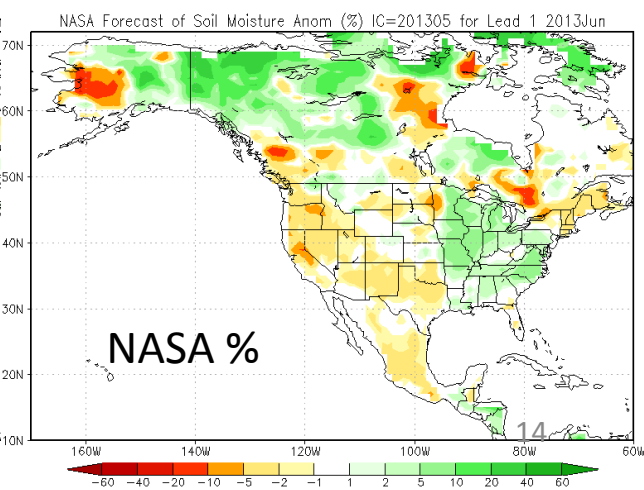
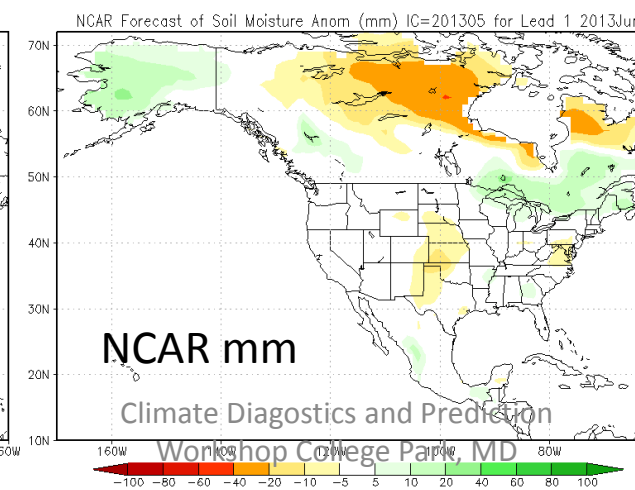
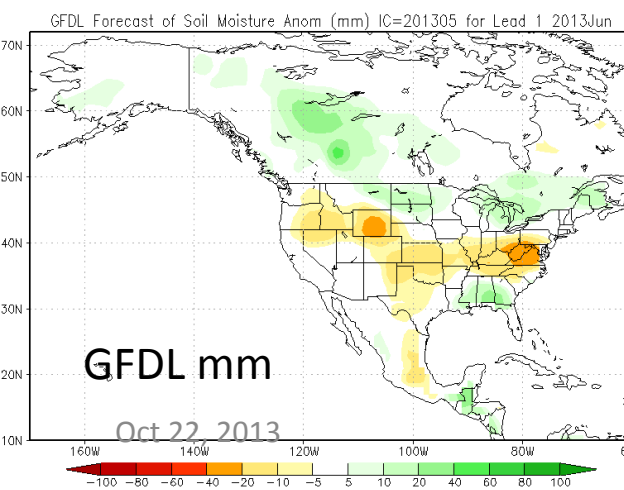


We borrow the color coding
from CPC Leaky Bucket's SM.

These are anomalies in mm.
Anomaly is a matter of
historical perspective.
Climo=1981-2010.
Typically ~50mm.



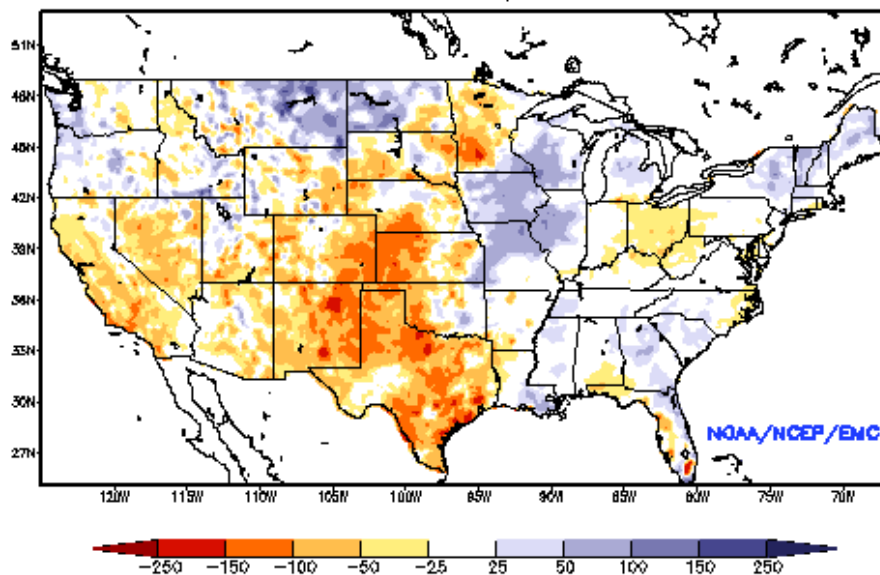
Units vary.
Only NASA looks realistic.



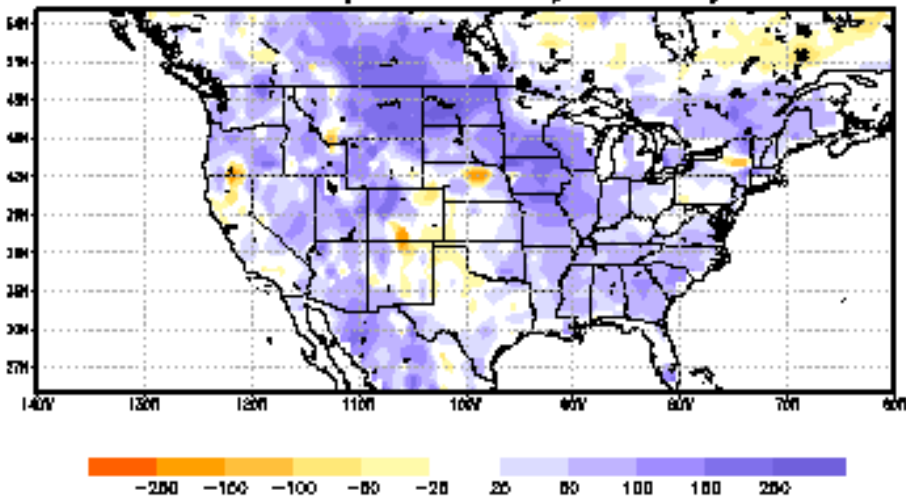
Soil Moisture Opr CFS Analysis for 31may2013



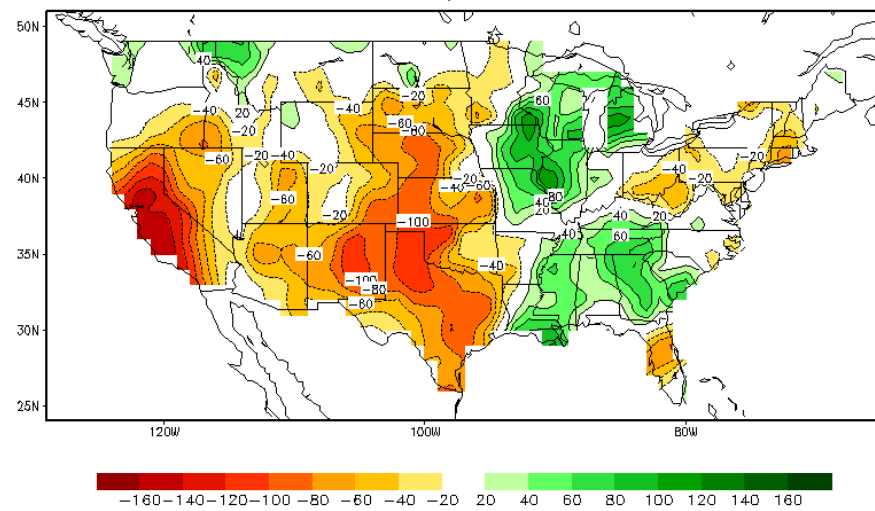
NCEP Noah - Current Total Column Soil Moisture Anomaly (mm)
Valid: MAY 31, 2013



Soil Moisture Opr CFS Anomaly for 31may2013



Calculated Soil Moisture Anomaly (mm)
MAY, 2013



Conclusions

- Most models appear to feed back onto surface air temperature (via evaporation) with the correct sign and seasonality, but somewhat stronger than ‘nature’. GFDL much too strong.
- Almost all models (CFSv2 especially) have major problems initializing soil moisture anomalies.
- 1+2: We have a long way to go to take advantage of any surface hydrology related predictability (such as it is).
- And by the way: there is no ENSO as test case in hydrology.

For your one stop shopping for NMME and
IMME products, visit

<http://www.cpc.ncep.noaa.gov/products/NMME/>

1800 jpegs a month!

Definitions and Data

- AC of ensemble averaged monthly means
- GHCN-CAMS (validation for Tmp2m)
- CMAP (validation for Prate)
- OIv2 (validation for SST)
- 1982-2009 (28 years)
- Common 2.5 degree grid
- Variables/areas studied: US T, US P, global and Nino34 SST, global and Nino34 Prate.
- ***A split climatology:*** Two climos used for all variables within tropics
30S-30N: 1982-1998 and 1999-2009
Elsewhere: 1982-2009

Definitions and Data

- Anomaly Correlation of ensemble averaged monthly means
- Variables/areas studied: global SST, Precipitation and land 2-meter temperature.
- GHCN-CAMS (validation for T2m)
- CMAP (validation for Prate)
- QD-OISST (validation for SST)
- 1982-2009 (28 years)
- Common 1.0 degree grid